Preblended Media

There is a strong inclination among growers to purchase preblended potting mixes from specialty firms. This trend toward use of preblended media is most developed in expensive mixes utilized in greenhouse production of small to medium size potted plants. These blends are sold in bags or in bulk.

Cheaper mixes are used primarily for landscape ornamental production beyond the liner stage and for large potted foliage plants. Use of local materials including peats, wood particles, bark and sand constitutes a considerable savings in component costs and the ultimate cost of the mix. These mixes are generally less uniform and consist of less persistent peat and other particles than those used in mixes consisting of high quality peat.

BMPS for Mixing and Handling Growing Media

- Test the media pH, electrical conductivity, and wettability before use.
- Select media components that ensure adequate water holding capacity of the mixture.
- Do not make changes to current growing media without first experimenting to see if changes may affect cultural practices.
- When mixing, thoroughly blend components, but do not over-mix, especially if a medium contains vermiculite or controlled release fertilizer.
- Do not store media that contains fertilizer, especially if the media is moist. The nutrient content may change or be lost.
- Avoid contamination of components for finished media by keeping amendments in closed bags or by covering outdoor piles.
- Do not allow mixes containing peat moss to dry out; rewetting is difficult.

Plant-Water Relationships

Water is essential for plant growth and is probably the greatest regulator of how well or how poorly a plant grows. Water is absorbed and used as a conveying vehicle for sugars, minerals and hormones within the plant, as well as in the process of transpiration to help control plant temperatures.

Water is transported throughout plants almost continuously. There is constant movement of water from the soil to the roots, from the roots into the various parts of the plant, then into the leaves where it is released into the atmosphere as water vapor. The total evaporative water loss from the soil and plant surfaces to the atmosphere is called ***evapotranspiration***.

Plants that are well-watered maintain their shape due to the internal water pressure of plant cells. This internal water pressure is known as ***turgor pressure***, and is necessary for plant cell expansion and consequently for plant growth. Loss of turgor pressure due to insufficient water supply can be noticed as ***wilting***.

The major economic consequence of insufficient water in plants is reduced overall growth. When too little water is available in the root zone, the plant will reduce the amount of water lost through transpiration by partial or total stomatal closure. This closure results in decreased photosynthesis since the CO_2 required for this process enters the plant through the stomata. Decreased photosynthesis reduces biomass production and results in decreased plant growth.

Soil-Water Relationships

The role of soil in the soil-plant-atmosphere continuum is unique. Soil properties directly affect the plant's availability of water and nutrients. Soil water indirectly influences plant growth through its effect on aeration, temperature, and nutrient transport, and its uptake and use in metabolism. Understanding these relationships is helpful in determining good irrigation design and management.

The range of water available to plants is between field capacity (FC) and the permanent wilting point (PWP). The soil is at ***field capacity*** when all the gravitational water has been drained and vertical movement of water due to gravity is negligible. The ***permanent wilting point*** is defined as the point where there is no more water held loosely enough in the soil to be available for plant use.

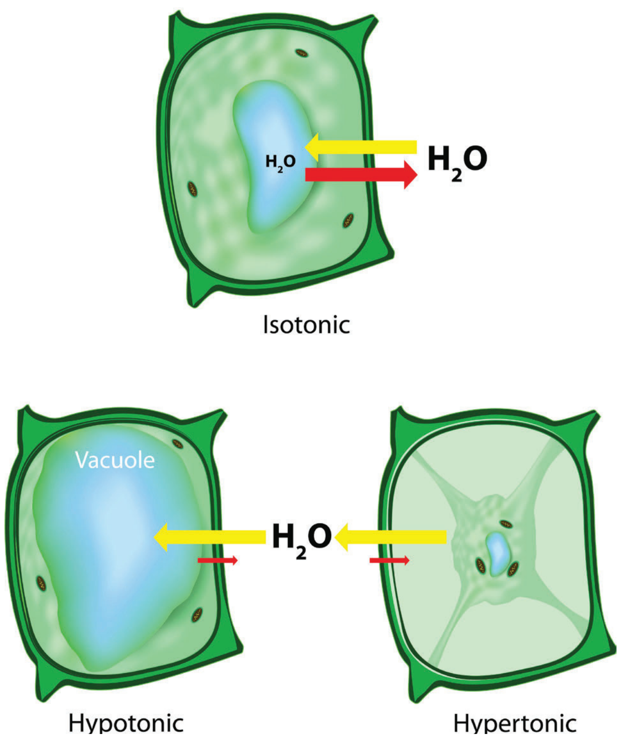

Figure 41. Water moves readily across cell membranes until pressure concentrations inside and outside the cell are equal (***isotonic***). If it is not equal, there will be net movement of water molecules into (***hypotonic***) or out (***hypertonic***) of the cell. Cells with adequate internal pressure are considered turgid.

Water Use

The main factors influencing the amount of water used by a plant are species, size, age, stage of growth, temperature, relative humidity and wind. Some plant species require large amounts of water to grow, while others, such as cacti, possess physical features to conserve water. Plant size is an important factor of water use because a large plant has a higher water use potential. Younger plants still require more water in relation to size than older plants, probably because of active growth. Actively growing plants also require more water than dormant plants.

Temperature changes the rate of water use, both directly by affecting evaporation and transpiration, and indirectly by affecting other plant processes. Warm temperatures tend to increase water loss while cool temperatures decrease water loss.

Relative humidity directly affects the rate of transpiration and evaporation. When relative humidity is high, the amount of moisture in the air and the moisture level at the leaf surface is very similar; therefore, water loss due to transpiration is decreased. With low relative humidity, transpiration increases as does subsequent water use by the plant. Wind can also increase evaporation and transpiration. All of these factors combine to determine the water use status of the plant.

Water Stress Symptoms

A plant is stressed when water loss through transpiration exceeds the ability to absorb soil moisture. Water stress symptoms can be observed in most plants, and are used to gauge when a plant needs water. One of the first symptoms of water stress is when soft leaves and stem tissue become limp or begin to wilt. This may occur first during the hottest, driest part of the day; however, within another day or two the symptom may be present most of the day. If the plant continues without water, it may remain wilted throughout the day. In

Causes of increasing water use	***Causes of decreasing water use***
Active growth	Dormancy
Higher temperatures	Lower temperatures
Low relative humidity	High relative humidity
Windy conditions	Calm conditions
Large leaf surface area	Small leaf surface area
Broad, thin leaf surface	Leaf modifications to minimize water loss

Figure 42. Comparison of factors influencing water use.

some plants, such as grasses, the foliage color is distinctly different (a bluish-green) when the plant is in the early stages of water stress.

Plants need water when they first begin to show water stress symptoms. If a plant is not watered, wilting can be followed by yellowing and dropping of older leaves then browning of tips or margins. If water deprivation continues, the entire leaf may turn brown and die; this can lead to the eventual death of the plant. Undetected symptoms may occur when a plant is getting only marginal amounts of water. Plant growth may slow down or stop due to water stress. The decreased growth may be incorrectly blamed on fertilization or pests. Water stress symptoms vary according to the plant, so the development of well-honed observation skills is important.

Figure 43. Spathiphyllum showing signs of water stress (e.g. wilted leaves, yellowed older leaves, browning of leaf margins and tips, death of flowers).

Symptoms of Excess Water

Excess water symptoms often are similar to symptoms of inadequate water. Under conditions of excess water, the soil lacks oxygen needed for root survival. As the root system deteriorates, the plant takes up less water. Often the decline of the root system is followed by invasion of root diseases. The root system should be examined if plants with adequate moisture in the soil show what appear to be water stress symptoms.

Irrigation

A good method for determining when to water is to observe plants for water stress symptoms. Indicator plants, which show stress a day or two before others, can usually be found. Then, observe plants regularly and water whenever the indicator plants show stress symptoms. This requires careful scrutiny to be sure indicator plants are in fact representative of the needs of the majority of plants being grown. Keep in mind that either species, media or the containers in which they are growing may differ. Small containers typically need water more frequently than large containers.

Another method of determining need is to monitor the moisture level in the soil with a reliable moisture meter or by feel. Judging soil moisture by feel should be done an inch or so under the soil surface, since the surface will dry out before there is a need to water. Watering by need, rather than an arbitrary schedule, often results in healthier plants.

Additional information on irrigation practices, frequency and efficient operation of irrigation systems can be found in the *Irrigation* chapter.

Water Quality

Water quality issues play an important role in determining plant performance. Chemicals, living organisms, and particulate matter affect water quality. Chemicals may injure plants, deposit undesirable residues on plants, or clog irrigation systems. Living organisms and particulate matter may also clog irrigation systems, and water borne pathogens may spread plant diseases through irrigation water.

Irrigation water pH may adversely affect the pH of growing media and may cause problems with applications of chemicals for pest control or fertilization. If water is high in soluble salts, fertilization procedures may have to be changed. If water is high in certain dissolved minerals, it may be necessary to avoid foliar application on some plants because of undesirable deposits on leaves that spoil the appearance. Water that has been softened by a sodium ion replacement system should never be used for plant irrigation due to potential sodium accumulation that may cause plant damage.

Surface water has the potential to be contaminated with chemicals and disease-causing organisms. If it is necessary to use surface water, care must be used to avoid contamination from herbicides or other pesticides and nutrient buildup. Algae or other particulate matter, which may clog automatic controllers and drip irrigation, can be adequately removed by filtering.

Reclaimed water nutrient levels can vary by a factor of 10 or more. When applying fertilizers to a site that irrigates with reclaimed water, consider the amount of nutrients in the water and reduce fertilization appropriately. In addition to possible nutrient pollution by over-irrigating, reclaimed water may contain high levels of chloride, leading to salt accumulations in the soil. Be sure to contact the reclaimed water supplier to get information on nutrient content and soluble salt levels.

Plant-Light Relationships

Light influences many aspects of plant growth and development; it is required for photosynthesis, the sole process for sustaining life. ***Light level (intensity)*** is a primary consideration when deciding what plants to use for a specific location. Some plants require full sun to grow satisfactorily and will not grow well in partial sun or shade. Plants adapted to shady environments need less light than plants adapted to full sun. Plants requiring partial shade can be used in sunny areas, if shade is provided during the higher intensity of the afternoon sun. Plants that do not receive enough light often grow weakly and become stretched or "leggy." Plants adapted to shade and lower light usually show signs of sunburn or scald when planted in too much sun. It is also important to reduce both irrigation and fertilization levels for plants in the shade to avoid fungal growth and stress.

In order for plants to survive successfully indoors, they must be able to adapt to low light levels. Field grown foliage plants in Florida are placed under shade cloth to be better adapted (***acclimatized***) to the low light of interiors. Plants that can withstand low light levels must be acclimatized if they are moved from an area with higher light. Conversely, sunscald occurs in plants exposed to bright sunlight after being in an area with lower light levels. This happens when a plant is moved from a protected area or when a plant is pruned and lower leaves are exposed to full sun.

In addition to light intensity, ***light duration*** also influences certain aspects of plant growth and development. Day length controls flowering in many species. The relationship of the length between day and night is known as ***photoperiod***. Daylight and darkness influence the rate of change in a light-sensitive pigment (phytochrome) responsible for triggering flowering at the appropriate time.

Flowering is initiated in some plants when the nights get longer. Examples of these ***short-day*** plants include chrysanthemum and poinsettia. Placing these plants under a light disrupts their perceived day length, and they will not bloom properly. Other plants bloom in the spring with flower initiation triggered

Figure 44. Sun scald on spathiphyllum leaves.